

Self-Assessment Checklist

Commercial Printing

What is Pollution Prevention?

Stopping pollution before it starts. Experts from industry, academia and government agree that pollution prevention means more than stopping pollutants from entering the eco-system or cleaning them up after the fact. These methods, pollution control and waste management, fall short of true prevention, which means going to the source and reducing - or preventing - the *formation* of the pollutants themselves.

How can we prevent pollution?

- Change our processes
- Change our products
- Change our raw materials
- Change our behavior

Many printers are now finding that pollution prevention pays. This information packet will help you learn how *you* can reduce waste and increase efficiency. No matter what size your print shop is, there are viable pollution prevention options for you.

Getting Started

While every print shop is different, there are many activities that are common to all. Like water, gas and electricity, waste management is another cost of doing business, which can be minimized with proper planning and consideration. This checklist provides a general overview of some quality control and pollution prevention options that can help printers achieve compliance and reduce waste.

Keep it on file for your use, and review it periodically. *Tips written in bold italics may be required by regulations, depending on your generation status and your location.* Many of the options highlighted here are summarized in more detail in the accompanying fact sheets. There are five main sections in this checklist:

1. General housekeeping
2. Image Processing
3. Plate processing
4. Printing
5. Finishing

1. General Housekeeping

Some housekeeping suggestions here may seem like common sense, but it is easy to take them for granted. Many printers are surprised to find that following these tips can help reduce waste generation by at least 20%. And it generally costs little or nothing!

A. OPERATIONAL PROCEDURES

How often do you check your equipment for operating efficiency? How well are your employees trained in noticing potential malfunctions?

| Yes | No | Not Sure | |
|-----|----|----------|---|
| | | | 1. Do you perform maintenance of equipment on a regular basis? |
| | | | 2. Are the roller blades kept in good condition and angles checked for the most effective press cleaning? |
| | | | 3. Do you clean presses immediately to help minimize cleaner consumption and prevent build-up of ink, paper-dust or lint that can affect print quality? |

B. INVENTORY CONTROL

Inventory control is all about common sense purchasing. What you bring into your shop (or don't bring in) ultimately determines what goes out.

| Yes | No | Not Sure | |
|-----|----|----------|---|
| | | | 1. Do you use materials on a first-in, first-out basis? This can help reduce the possibility of expired shelf life or obsolescence. |
| | | | 2. Do you practice "just-in-time" material acquisition? Purchasing materials on an as-needed basis will further help prevent spoilage or obsolescence. |
| | | | 3. Do you have a computerized inventory system? Computers can help track the amounts and ages of raw materials. |
| | | | 4. Do you purchase quantities according to needs? Buying in bulk can often reduce packaging waste, and is usually cost-effective. Conversely, buying infrequently used materials in small quantities may prevent waste as a result of expiration. |
| | | | 5. Do you accept "free samples?" It is not good policy to accept samples unless you know you will use the entire sample. If the sample is hazardous, you are stuck with the responsibility of proper disposal. |
| | | | 6. Do you test out-of-date materials before disposing of them? Expiration dates are just estimates. Often the product is still good long after the labeled date. Also, find out if expired or obsolete materials can be returned to the supplier. |

C. TRAINING

The Federal Occupational Safety and Health Administration (OSHA) requires every individual that is in contact with any hazardous material(s) to be comprehensively trained on proper chemical handling procedures, how to read a Material Safety Data Sheet (MSDS), what to do in case of an emergency, and the health hazards associated with each chemical they come in contact with. Some trade associations and local environmental health agencies sponsor employee-training seminars and some consulting firms offer employee training as part of their package of services for hazardous waste management.

| Yes | No | Not Sure | |
|-----|----|----------|---|
| | | | 1. Are you familiar with regulations affecting your business? It is your responsibility to know and understand all regulations (federal, state and local), which apply to your business. Ignorance of the law is no excuse. |
| | | | 2. Do you conduct required training on hazardous materials? Training personnel on safety in the shop and worker right-to-know is required by federal and state law, even if you only employ one person. Many state laws require a safety director be named for any business with 5 or more employees. Safety training will ensure employees are informed on current materials and material handling techniques, and will cover the employer's liability if a hazardous situation arises. |
| | | | 3. Is a Material Safety Data Sheet (MSDS) retained for each chemical used in the business, and are employees trained on how to read and use MSDS's for all chemicals? A business must have an MSDS for each material used in the business. An MSDS helps employees determine the nature of a chemical or product being used and potential hazards associated with it, including worker health and safety concerns, spill cleanup and disposal recommendations. Keep MSDSs in an area where employees have access to and may examine them. A three-ring binder may be useful for filing them. |
| | | | 4. Are employees trained on spill prevention and other pollution prevention practices? Segregation of wastes, spill prevention and waste minimization can prevent unneeded costs and unnecessary generation of hazardous waste. Moreover, properly trained employees are less likely to misuse costly products, thereby reducing the amount of waste generated by spills and improper handling storage of hazardous materials. |
| | | | 5. Do you have an emergency plan, and have employees been trained on how to respond in the case of an emergency? |

D. MATERIAL HANDLING AND STORAGE

Additional hazardous waste may be generated if raw materials or hazardous wastes are stored improperly. All containers need to be clearly labeled. Store in closed containers, preferably in a locked, covered, indoor area with a concrete floor and curbs for spill containment.

| Yes | No | Not Sure | |
|-----|----|----------|--|
| | | | 1. Are all received drums, packages, and containers fully inspected for damage before being accepted? |
| | | | 2. Are all containers labeled? Labeling all containers - including hazardous and non-hazardous materials and wastes - can prevent costly mistakes caused by using the wrong chemical. |
| | | | 3. <i>Are all wastes kept segregated?</i> It is critical to store all wastes separately. Mixing hazardous waste with other wastes makes the whole thing hazardous, thereby increasing disposal costs and liability potential. Mixing wastes may also make recycling or reuse impossible. |
| | | | 4. <i>Are containers kept closed and secured?</i> All generators of hazardous waste are required to keep containers closed at all times unless adding or removing wastes. The containers must also be in good condition and free of leaks. Covering products can help save money by reducing evaporative losses. |
| | | | 5. Do you use funnels when transferring wastes to storage containers? |
| | | | 6. Are containers diked, and is the dike coated on the surface with a sealer? Is secondary containment used? The more you can do to prevent and contain spills, the less liability you will face. You may also consider keeping track of where spills have occurred so that you can take precautionary measures in the future. |
| | | | 7. Are materials properly stored to prevent possible damage or contamination from heat or cold, excessive light, or excessive moisture? Is paper stored in an environmentally controlled area? |

2. Image Processing

A. PROCESS BATHS

Carefully monitoring all photo-processing baths can help extend the life of chemicals and reduce waste, thereby saving money.

| Yes | No | Not Sure | |
|-----|----|----------|---|
| | | | 1. Are bath temperatures and pH monitored frequently and maintained at recommended conditions? |
| | | | 2. Have you tried to reuse or recycle photo-processing chemicals after silver removal? |
| | | | 3. Do you use counter-current rinsing to conserve water? |
| | | | 4. Do you use floating lids on bleach and developing containers to keep them fresh and reduce evaporative losses? |
| | | | 5. Do you use less- or non-hazardous raw materials, such as low-hydroquinone developers and low-replenishment developers, wherever possible? |
| | | | 6. Have you considered electronic imaging and/or laser plate making to reduce the need for photographing and reshooting? (This alternative may be costly, and is not a feasible option for most small printers. Consider the payback period.) |
| | | | 7. Do you containerize process baths to protect them from spoiling? Glass marbles can be used to bring the liquid level to the brim of the container. |
| | | | 8. Do you use squeegees to reduce chemical loss from manual photo-processing? |
| | | | 9. <i>Do you attach labels to your used fixer containers, identifying them as hazardous wastes?</i> |

B. SILVER MANAGEMENT

Used fixer from film developing processes contains silver, a toxic heavy metal. Concentrations of silver in used fixer usually far exceed allowable limits for discharge to municipal water systems, and therefore must be controlled with silver recovery technology.

| Yes | No | N/A | |
|-----|----|-----|---|
| | | | 1. Are electronic pre-press systems used to prepare copies? This can help reduce solid and hazardous waste streams from pre-press operations, thereby saving money in reduced disposal and liability costs. |
| | | | 2. <i>Is silver removed or recovered from photo-processing waste streams prior to discharge?</i> |

3. Plate Processing

Gravure printing, metal etching and metal plating operations are not covered in this packet because these processes are covered in informational materials related to metal casting and finishing.

| Yes | No | N/A | |
|--------------------------|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. Have you considered plastic or photopolymer plates (they are typically processed with water solutions, containing little or no hazardous wastes). |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. Do you use presensitized plates? (Water-based solutions are currently available and widely used.) |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. Have you considered aqueous plates? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. Have you considered double-sided plates? While these may present quality limitations for some lithographic printers, many newspapers have successfully employed them. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. Are plate processor conditions frequently monitored? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. Are spent plates recycled? Most recyclers pay printers for aluminum printing plates. |

4. Printing

Which of the following press automation features have been added, or are proposed to be added, to reduce make ready times, improve quality and reduce paper waste (many of these technologies may be appropriate for larger printers):

- Automated plate benders
- Automated ink key setting systems
- Ink/water ratio sensors
- Automated plate scanners
- Computerized registration

A. FOUNTAIN

Use of isopropyl alcohol (IPA) -- a volatile organic compound (VOC) -- is restricted by increasingly stringent Clean Air Act regulations. Printers should seek ways to reduce their use of IPA.

| Yes | No | Not Sure | |
|--------------------------|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. Have you considered using alcohol substitutes, low- or non-alcohol solutions? |

| | | | |
|--------------------------|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. Have you considered using a recirculating chiller unit that keeps fountain solution clean and reduces evaporation? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. Have you considered metered dampening systems to reduce wastes? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. Do you check pH for consistency in each fountain solution batch? (Some printers find that a pH of 4-5 is effective for maintaining quality). |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. <i>Do you know whether or not your fountain solution is hazardous waste?</i> Some components of fountain solutions, such as ethylene glycol, may make spent fountain solution hazardous. |

B. INKS

Some inks present health and environmental hazards because they may contain volatile organic compounds (VOCs), which contribute to air pollution and lead to the formation of smog, and because they may contain hazardous constituents such as heavy metals or toxic stabilizers. Product substitution and/or effective ink management can help reduce risk of exposure to these hazards, and can reduce waste.

| Yes | No | Not Sure | |
|--------------------------|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. Have you considered the following alternative inking systems: <ul style="list-style-type: none"> • Heat-reactive inks • UV-cured ink systems • Electron-beam-dried ink systems |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. Have you considered less hazardous inks such as soy- and water-based inks (for non-lithographic printers), and inks which do not contain metals? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. Are ink fountains filled according to expected needs, as opposed to routine filling? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. Are ink containers properly sealed after use? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. Do you schedule, when possible, similar-color jobs simultaneously to reduce waste generation between cleanup and start of next run? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. Do you recycle or reuse old inks for marketing as "house colors" (Note that the quality of inks mixed with a variety of additives may be affected over time.) |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. Have you considered computer ink blending programs to minimize waste of special, uncommon inks? (This option is more appropriate for larger printers). |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. Have you considered either on-site or off-site ink recycling? (Typically, very large volumes of ink are needed to make this option feasible.) |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 9. Do you prevent ink from drying or skinning inside the fountain? Good |

| | | | |
|--------------------------|--------------------------|--------------------------|--|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | operation practices such as keeping ink containers sealed and contents leveled, as well as anti-skinning sprays can help reduce waste ink. |
|--------------------------|--------------------------|--------------------------|--|

5. Finishing

The clean-up stage presents many feasible and common sense opportunities to prevent pollution.

| Yes | No | Not Sure | |
|--------------------------|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 1. Do you train employees to use the least amount of cleaner possible? Also, it is generally more efficient to apply the cleaner to the shop towel, rather than pouring it over the part. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 2. Are all solvents and cleaners stored in closed containers? This can help minimize evaporative losses, and avoid spills or exposure. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 3. Can the waste solvent be collected and used as thinner? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 4. Have automatic blanket cleaners been considered? When used effectively, these units can improve productivity and reduce make ready, as well as cleaning needs. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. Can soaps and detergents be used for certain cleaning? Use solvents only for their intended purpose. Check with the supplier to determine the best alternative cleaning methods for your products and equipment. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. Can cleaning solvent be recycled? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. If you use webs, do you have web break detectors, and automatic web splicers to save time and reduce paper waste? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. Is waste lube oil sent to a recycler? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 9. Do you clean with reusable, launderable shop towels instead of disposable paper? Disposable shop towels are wasteful, and may be disposed of in a landfill only if they are determined to be non-hazardous; otherwise they must be managed as hazardous waste. Launderable rags that bear free liquids are not subject to hazardous and solid waste regulations. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 10. Is waste paper separated and segregated and sent to a recycler? |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 11. Have you considered waste exchanges to find potential users for your off spec and overstock inks? Local schools, art and theater departments often have uses for these inks. |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 12. Has on-site distillation of spent solvent been considered? (On-site distillation is typically economically feasible for printers who generate at least 8 gallons of solvent waste per day). |

Pollution Prevention Opportunities for Printing

The keys to pollution prevention in printing are material substitution (nonmetal inks), minimization of changeover, and ink recycling.

| <u>Y/N</u> | <u>Opportunities</u> | <u>Comments</u> |
|------------|----------------------------|--|
| I. | Good Operating Practice | |
| ___ | Segregate waste streams | Spent fix baths should be segregated from rinsewaters and developer solutions because silver recovery is more efficient on more the more concentrated spent fix waste stream. |
| ___ | Control inventory | Do not allow material to exceed shelf life and then have to be discarded as waste. Use materials on a first-in, first-out basis. Do not get rid of expired products by discharging to wastewater treatment system. |
| ___ | Adjust replenishment | Adjust chemical replenishment rates and washwater flow rates on photoprocessor to optimize bath life and reduce wastewater quantity. |
| ___ | Keep lids on solutions | In storage, keep lids on bulk solutions to prevent oxidation and contamination of these solutions. |
| ___ | Minimize spills | Use dry method cleanups. |
| ___ | Return used ink to vendor | Purchase ink from distributors that will take back unused or spent ink, so ink will not be discharged to the sewer. |
| ___ | Run similar jobs at once | Minimizes need for cleaning between jobs. |
| ___ | Use non-dry aerosol | Special non-drying aerosol materials can be sprayed on ink fountains to keep them from drying out overnight. Fewer ink fountain cleanings required. |
| II. | Material Substitution | |
| ___ | Change to silverless film | Silver does not end up in rinsewaters or spent fix baths when this type of film is used. Examples include vesicular, diazo, and electrostatic films. |
| ___ | Change to ultraviolet inks | Will not dry in ink fountain overnight. Reduces need for fountain cleaning. |



II. Process Modification

| | |
|--------------------------------|--|
| ___ Add ammonium thiosulfate | Addition of this chemical to silver contaminated bath extends the useful life of the bath |
| ___ Purchase new machines--1 | Purchase new developing machines that use less rinsewater (e.g., countercurrent rinsing) and/or have squeegees or air blades to reduce dragout from chemical baths to rinsewaters. |
| ___ Purchase new machines--2 | Purchase waterless paper and film developing machines to reduce the volume of fix waste. |
| ___ Add acetic acid | Acetic acid added to the fix bath keeps the pH low to maximize soluble complexes, therefore, extend bath life. |
| ___ Install electronic imaging | Eliminates need for photoprocessing. Expensive. |
| ___ Install laser platemaking | Eliminates need for photoprocessing. Expensive. |
| ___ Use flexographic process | Replaces metal etch processes for plate processing. |

IV. Material Recovery

| | |
|----------------------------------|---|
| ___ Recover fix bath silver | Install electrowin unit on fix bath of photoprocessor. Extends bath life. |
| ___ Install electrowin | Install electrowin unit on first rinse and developer waste streams to recover silver from solution and reduce toxicity of wastewater. |
| ___ Metal replacement canister | Install canister on rinsewaters and on effluent of wastewater electrowin to recover silver from solution and reduce toxicity of wastewater. |
| ___ Install rinsewater recycling | Reduces wastewater. |
| ___ Recycle inks | Recycle inks to make black ink instead of discharging to sewer. |

Pollution Prevention Opportunities for Photoprocessing

The keys to pollution prevention in photoprocessing are to minimize washwater use, extend bath life, recover silver, and recycle bleach fixer solution.

| <u>Y/N</u> | <u>Opportunities</u> | <u>Comments</u> |
|------------|---------------------------|--|
| I. | Good Operating Practice | |
| ___ | Segregate waste streams | Spent fix baths should be segregated from rinsewaters and developer solutions because silver recovery is more efficient on the more concentrated spent fix waste stream. |
| ___ | Control inventory | Do not allow material to exceed shelf life and then have to be discarded as waste. Use materials on a first-in, first-out basis. Do not get rid of expired products by discharging to wastewater treatment system. |
| ___ | Adjust replenishment | Adjust chemical replenishment rates and washwater flow rates on photoprocessor to optimize bath life and reduce wastewater quantity. |
| ___ | Keep lids on solutions | In storage, keep lids on bulk solutions to prevent oxidation and contamination of these solutions. |
| II. | Material Substitution | |
| ___ | Change to silverless film | Silver does not end up in rinsewaters or spent fix baths when this type of film is used. Examples include vesicular, diazo, and electrostatic films. |
| III. | Process Modification | |
| ___ | Add ammonium thiosulfate | Addition of this chemical to silver-contaminated bath extends the useful life of the bath |
| ___ | Purchase new machines | Purchase new developing machines that use less rinsewater (e.g., countercurrent rinsing) and/or have squeegees or air blades to reduce dragout from chemical baths to rinsewaters. |
| ___ | Add acetic acid | Acetic acid added to the fix bath keeps the pH low to maximize soluble complexes, therefore, extend bath life. |
| IV. | Material Recovery | |
| ___ | Recover fix bath silver | Install electrowin unit on fix bath of photoprocessor. Extends bath life. |
| ___ | Install electrowin | Install electrowin unit on first rinse and developer waste streams to recover silver from solution and reduce toxicity of wastewater. |

____ Metal replacement cannister

Install cannister on rinsewaters and on effluent of wastewater electrowin to recover silver from solution and reduce toxicity of wastewater.

____ Install rinsewater recycling Reduces wastewater.

Prepared by Alison Gemmell, CH2M Hill and Philip Lo, CSDLA, 12/90.

(WP, PHOTO)

Internet Resources for Printers

Pollution Prevention for the Printing Industry: A Manual for Pollution Prevention Technical Assistance Providers; Illinois Waste Management and Research Center; 1997 (<http://www.wmrc.uiuc.edu/manuals/printing/toc.htm>)

A Guide For Lithographic Printers; Washington State Department of Ecology Environmental Management and Pollution Prevention; May 1996 (<http://www.ecy.wa.gov/pubs/94139.pdf>)

Printers Protecting the Environment; Pennsylvania Department of Environmental Protection; 1997 (<http://cfpub.epa.gov/clearinghouse/preview.cfm?ResourceID=248334>)

Multimedia Compliance/Pollution Prevention Assessment Guidance for Lithographic Printing Facilities; USEPA Office of Enforcement and Compliance Assurance; June 1996 (<http://cfpub.epa.gov/clearinghouse/preview.cfm?ResourceID=248101>)

Guides to Pollution Prevention: The Commercial Printing Industry; USEPA Office of Research and Development; August 1990 (<http://www.p2pays.org/ref/02/01063.pdf>)

Improve Efficiency and Reduce Waste Through Process Control in the Lithographic Printing Industry; Institute of Advanced Manufacturing Sciences Inc. and Printing Industries Association of Southern Ohio and US EPA; 1997 (http://www.iams.org/iamsorg/pollution_prev/printweb.HTM)

An Analysis of Pollution Prevention Opportunities and Impediments in the Printing and Publishing Industry Sector in Georgia; Georgia Department of Natural Resources (<http://www.ganet.org/dnr/p2ad/pblcations/printsec.htm>)

Pollution Prevention Manual for Lithographic Printers; Iowa Waste Reduction Center, University of Northern Iowa; 1995 (<http://es.epa.gov/program/regional/trade/litho-mn.html>)

Pollution Prevention For The Printing Industry; Research Triangle Institute; 1999 (<http://www.getf.org/file/toolmanager/O16F4815.pdf>)

Green Zia Environmental Excellence Program: Printing; New Mexico Environmental Department (http://www.nmenv.state.nm.us/Green_Zia_website/Printing_Packet.pdf)

Commercial Printing Industry - Compliance and Pollution Prevention Workbook; Pacific Northwest Pollution Prevention Resource Center (PPRC); 1997 (<http://www.pprc.org/pprc/sbap/workbook/tocprint.html>)

Pollution Prevention Checklist for Lithographic Printers; Printer's National Environmental Assistance Center (PNEAC) (http://www.pneac.org/sheets/litho/p2_cklist_litho.html)

Profile of the Printing and Publishing Industry; US EPA Office of Compliance Sector Notebook Project; 1995 (<http://es.epa.gov/oeca/sector/sectornote/pdf/print.pdf>)

Flexographic Ink Options: A Cleaner Technologies Substitute Assessment; US EPA Design for the Environment (DfE); 2002 (<http://www.epa.gov/oppt/dfe/pubs/flexo/ctsa/index.html>)

Solutions for Lithographic Printers – An Evaluation of Substitute Blanket Washes; US EPA DfE, 1997 (<http://www.epa.gov/oppt/dfe/pubs/lithography/lithbkst.pdf>)

Designing Solutions for Screen Printers – An Evaluation of Screen Reclamation Systems; US EPA DfE, 1996 (<http://www.epa.gov/oppt/dfe/pubs/screen/ctsa/scbook.pdf>)